DRAFT STATEMENT OF WORK

for

Technical Services for Aerospace Systems Modeling and Simulation III
(SimLabs III)

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1.0   Background

This statement of work describes a requirement for operations, development, maintenance, and modification of the Simulation Laboratory Facilities located at the National Aeronautics and Space Administration's (NASA) Ames Research Center (ARC). The contract consists of a Core Requirement, Contract Line Items (CLINs) 01A, 02A and 003A, Section 3.5 of the SOW. The contract also consists of an IDIQ requirement, CLINs 01B, 02B, and 003B, Sections 3.1 through 3.4 of the SOW, as authorized by NASA through Task Orders.

Task Orders: Specific authorization or direction to perform work within the scope of the contract and as specified by NFS 1852.216-80. Task Orders must clearly describe all services to be performed or supplies to be delivered so the full cost or price for the performance of the work can be established when the order is placed. Orders shall be within the scope, issued within the period of performance, and be within the maximum value of the contract.

Work Assignments: Technical direction given within the scope of a task order.

1.1   Mission Description

The Simulation Laboratory Facilities are unique national research and development facilities dedicated to providing researchers with high-fidelity environments in which to conduct simulated flight and air traffic management research and to advance the state-of-the-art of simulation technology. Researchers use the facilities to investigate a variety of topics ranging from the design of new aircraft guidance and control systems to the human factors implications of new or existing flight deck displays, airspace operations, air traffic control and automation. In-house projects and experiments are conducted to develop new simulator systems and subsystems, improve simulation systems, develop advanced engineering techniques to improve the fidelity and validity of simulation programs, and incorporate the latest technology into simulation systems.

The Simulation Laboratory Facilities are primarily comprised of the Crew-Vehicle Systems Research Facility (CVSRF), the Distributed Simulation Research Laboratory (DSRL), the Vertical Motion Simulation Complex (VMSC), FutureFlight Central (FFC), and the 210 Air Traffic Control (ATC) Lab.

The Aeronautics Directorate at NASA Ames currently manages the Simulation Laboratory Facilities through civil service line managers, who, in conjunction with the Contractor, are ultimately responsible for the successful performance of the mission of each facility.

The Contractor is responsible for the successful preparation and operation of the simulators, collection of research data, and the continuing operation and upgrade of the facilities. It is not the responsibility of the Contractor to ensure that the data validate or invalidate any scientific theories, ideas, or designs.

The Contractor is also responsible for development, testing, and validation of advanced air traffic management automation tools being developed at NASA Ames. These tools are integrated in the full simulation environment to support future research.

The simulation facilities are used by NASA programs, other NASA Centers, the Federal Aviation Administration, the Department of Defense, the National Transportation Safety Board, other government organizations, industry and universities.

1.2   Simulators/Facilities

The work in these facilities includes simulation of a wide variety of aircraft configurations including helicopters, advanced lift-fan aircraft, jet transports, modern concepts for Vertical/Short Take-Off and Landing (V/STOL) vehicles, Space Craft, Lunar Lander, Unmanned Aerial Systems (UAS), and their guidance, control, and mission management systems, as well as air traffic management. The developmental nature of the work involves the continuous upgrading of capabilities, facilities and the advancement of the state-of-the-art of simulation technology.

Vertical Motion Simulation Complex

The VMSC with its large amplitude motion system that provides piloted, real-time flight simulation of proposed and existing vehicles. The dynamic and flexible research environment lends itself to simulation studies involving controls, guidance, displays, automation, handling qualities, flight deck systems, and accident/incident investigations. The facility is used to examine new guidance and control law algorithms and to evaluate handling qualities and characteristics. The VMSC, besides the large motion capability, has other laboratories for development, checkout and fixed base operations and five interchangeable cabs which are configured for a given simulation requirement. In addition, the facility includes the Distributed Simulation Research Laboratory (DSRL). The DSRL provides the infrastructure for distributed UAS in the NAS and ATC simulations.

Distributed Simulation Research Laboratory

The DSRL provides a distributed test environment incorporating Live, Virtual, Constructive (LVC) concepts developed to execute standalone and integrated simulations and flight-tests that support unmanned aircraft research for NASA's UAS in the National Airspace System (NAS) Project. The LVC components form the core infrastructure that supports simulation of UAS operations by integrating live and virtual aircraft in a realistic air traffic environment. This LVC infrastructure enables efficient testing by leveraging the use of existing distributed assets. The LVC concepts used for the UAS in the NAS project include live aircraft, flight simulators, and virtual air traffic control assets operating at facilities distributed across multiple NASA Centers.

Crew-Vehicle Systems Research Facility

The CVSRF is used to analyze human factors for flight crews, formulate principles and design criteria for future aviation environments, evaluate new air traffic control procedures, develop and evaluate air/ground automation, and

support integrated simulations with facilities across Ames and across the country through the use of full-mission simulation. The CVSRF includes two full mission flight simulators, a Boeing 747-400 Flight Simulator and an Advanced Concepts Flight Simulator (ACFS). In addition, the facility includes an ATC Radar Lab, which is used to simulate *enroute* and TRACON air traffic control facilities. The ATC Radar Lab can be interconnected with other SimLabs facilities to support cross-domain or air/ ground integration research projects.

FutureFlight Central

FFC is a full-scale ATC tower simulation facility used to test and evaluate airport design operational issues. The facility features a 360-degree immersive visual environment. As an air traffic control tower simulator, FFC allows stakeholders such as the Federal Aviation Administration (FAA), controllers, pilots, airports, and airlines to develop and test advanced surface and terminal area concepts and automation. FFC supports research into the interaction between airport towers, between tower controllers and pilots, and between Terminal and TRACON controllers including NextGen and beyond automation concepts and tools. FFC is also used to test procedural changes, enhance airport ramp procedures, optimize taxi routes and examine the implementation of new technologies to improve airport surface management and operations.

FFC has an extensive video streaming capabilities, which combined with the 3-D database capability makes the facility ideal for any research needing immersive virtual and/or video environments. FFC has been used as a real time visualization tool for remote science and remote robotics field-testing.

N-210 ATC Laboratory

The N-210 ATC Laboratory is a self-contained development/ research facility that supports air traffic controllers, pseudo pilots and auxiliary systems for simulation of any airborne air traffic management domain. The facility can be interconnected with other Simlabs facilities to support cross-domain or air/ground integration research projects.

Technical services are provided in support of air traffic management projects. These include the software design, development, and implementation of real-time ATC simulation tools, and ATM concepts, automation and collaborative decision making tools, SimLabs supports integrated simulations across multiple ATM domains including air/ground technologies.

Simulation environment consists of:
- Tightly coupled hard real time simulations and widely distributed soft real time simulations
- Simulation software and hardware ranges from vender supplied proprietary black box software and hardware, to in-house developed software and hardware, to open source applications, to externally sourced but internally modified and maintained software and hardware, each piece obtained from NASA or other government agencies, outside venders, government Contractors, and industry and academic partners. All facilities consist of many of these pieces integrated into highly configurable, highly customizable, high fidelity research facilities.

- Simulation development and operations take place in a very dynamic research environment with rapidly changing requirements and priorities, and tight schedules. Management and workforce must be flexible and able to work within that environment.

1.2.1 Location of Simulators/Facilities

The Simulation Laboratory Facilities are currently located in Buildings N-243, N-257, N-210 and N-262. These facilities are collectively referred to as SimLabs.

1.2.2 Simulators and Related Facilities

1.2.2.1 Crew-Vehicle Systems Research Facility (CVSRF) - Building N-257

- Advanced Concepts Flight Simulator (ACFS)
- Boeing 747-400 Flight Simulator
- Air Traffic Control (ATC) Simulation Laboratory

1.2.2.2 Vertical Motion Simulation Complex (VMSC) - Building N-243

- Vertical Motion Simulator (VMS)
- Interchangeable Cab 1 (I-Cab1) fixed-base area
- Interchangeable Cab 2 (I-Cab2) fixed-base area
- Distributed Simulation Research Laboratory (DSRL)

1.2.2.3 FutureFlight Central – Building N-262

- Air Traffic Control Tower Simulator
- Ramp Controller stations
- Pseudo- Pilot Room

1.2.2.4 210 ATC Laboratory - Building N-210

- Air Traffic Control Laboratory
  - Standard Terminal Automation Replacement System (STARS) air traffic control stations used by some TRACONs around the United States
  - Multi- Aircraft simulated Air traffic control stations
  - Single and Multi- Aircraft Pseudo- Pilot stations

2.0 Scope

Responsibility for NASA-Ames' SimLabs Flight Simulation Complex is shared between the Civil Service staff (hereafter referred to as NASA) and its prime Contractor (hereafter referred to as Contractor).
NASA is responsible for the:

- Management and performance of the Flight Simulation Facilities.

- Solicitation and acceptance of research customers.

- Scheduling and planning all simulation resources and labs for all simulation experiments and simulation technology projects in the SimLabs.

- Technology assessment, the definition of long-term requirements and new capabilities for simulation systems and technology, and the acceptance and integration of new technology.

- Safe operation of all facilities in compliance with ARC Human Occupancy requirements.

- Prioritization of projects

NASA supplies general and specific office supplies and equipment, logistical services, and plant engineering management of buildings and building systems.

The Contractor is responsible for the:

- Technical development, integration, validation, and operation of research experiments to meet the SimLabs mission. The Contractor is responsible for ensuring the fidelity and integrity of the facilities and the simulation software and the quality of the experiment data. Individual subsystems and integrated simulations must perform according to specifications and research requirements.

- Design, development, integration, and validation of deliverables from facility upgrade and other projects.

- Preparation and maintenance of plans for coordinating preventive and corrective maintenance activities and minimizing facility downtime. When corrective maintenance is required, the Contractor shall ensure that the correct procedures are followed and that the response escalates at predetermined points based on the how long the facility has been down, and the impact to operations.

- Compliance with all safety testing, and adherence to procedures and regulations concerning maintenance and operations of SimLabs' facilities, safety critical software, hazardous material, and personal safety standards as required by NASA and OSHA.

Tasking is defined by work assignments and/or authorized task orders.

The Contractor shall provide appropriate personnel resources to support the design, development, integration, testing, validation, and execution of experiments, and produce required project management and experiment documentation and deliverables including participant evaluations, research data, and other deliverables as specified by customer requirements and SimLabs procedures.

The Contractor shall respond to changing SimLabs schedules and priorities.

The Contractor shall complete discrete projects, as authorized by NASA through work assignments and/or task orders, aimed at improving or adding new capabilities to the simulation laboratories or facilities.

The Contractor shall support ATM customers by designing, developing, integrating, testing, validating, and maintaining ATM simulation tools, simulating ATM concepts, and ATM automation. The Contractor shall conduct ATM simulations and produce the required project management and experiment documentation and deliverables including participant evaluations, research data, and other deliverables as specified by customer requirements and SimLabs procedures.

The Contractor shall ensure the safety, quality, integrity and maintenance of simulators, and facilities. If a modification to a simulator facility could impact the safety of participants or confederates, the Contractor shall support developing any analyses required to satisfy NASA's Human Occupancy Review Board and making any changes to software, hardware, and procedures required to ensure that safety requirements are met. Additionally, if the facility modification could impact the safety of the equipment or the personnel operating or supporting the facility, the Contractor shall provide support in developing any analyses required to demonstrate to the Safety and Mission Assurance (SMA) Organization that safety hazards and risk have been addressed appropriately and make any changes to software, hardware, and procedures required to ensure that safety requirements are met.

This SOW is organized to focus on the main purpose of the Simulation Facilities, namely the conduct of research experiments and discrete simulation technology projects. Section 3.1 is dedicated to specific phases in the experiment cycle. Section 3.2 addresses the requirements associated with the performance of discrete projects such as facility repair or simulation technology enhancements. Section 3.3 addresses the requirements of preventive and corrective maintenance. Section 3.4 addresses the functional capabilities necessary to meet the requirements in Section 3.1, 3.2 and 3.3. Section 3.5 addresses core functions such as administration, procurement, documentation, configuration management, outreach, environmental compliance, SMA, and property management. While these supporting functions may not directly relate to the design, planning, preparation, conduct and data acquisition/reduction related to specific simulations or projects, each plays a vital role in facilitating the success of these activities.

3.0   Requirements

3.1   Experiments

The process cycle for a successful simulation includes planning, preparation, operations and post-operation activities. The Contractor shall use the functional capabilities defined in section 3.4, as necessary to achieve the goals of each experiment.

The specific requirements that apply to each of these phases are given below.

3.1.1   Experiment Planning

Experiment planning focuses on development of the technical and project management approaches, technical objectives, performance incentives, risk allocation, and performance metrics with a focus on identifying key

actions/deliverables to be used to assess the success (or failure) of Contractor performance. As necessary to meet the requirements defined in the work assignments and/or authorized task orders, the Contractor shall meet the following specific requirements:

3.1.1.1   The Contractor shall define, develop, operate, and maintain an experiment resource control system, which will track the experiment schedule, finances, and configuration for each specific project/simulation.

3.1.1.2   The Contractor shall generate an Experiment Implementation Plan (EIP) that outlines the Contractor's approach to the technical objectives throughout the preparation, operations, and post-operations phases. The EIP requires Government approval. The EIP shall:

- Define the tasks necessary to perform the experiment, the associated resources, schedule and budget.
- Address special matters pertaining to Safety and Mission Assurance (SMA), environmental compliance, configuration management, maintenance, and facilities integrity.
- Address any known technical and cost risks appendant to the Contractor's proposed approach.
- Define the Contractor's approach in refining the simulation requirements necessary to meet the research objectives.

3.1.2   Experiment Preparation

With the planning phase complete, preparation for the experiment is required. The extent, complexity, and duration of preparation activities will vary from experiment to experiment. For most experiments, hardware, systems software, applications programming, electrical, electronic, and mechanical development will be required in order to prepare all facets of an experiment. This phase includes all activities from completion of project-specific planning to the beginning of the actual experiment.

Experiment preparation shall be implemented in accordance with the approved EIP. As part of the preparation for an experiment, the Contractor shall meet the following specific requirements:

3.1.2.1   The Contractor shall generate experiment operations plans and procedures, along with foreseeable contingencies, as described in the EIP.

3.1.2.2   The Contractor shall complete the systems engineering, installation, integration, and validation of all mechanical, electrical, hardware, and computer systems necessary for the performance of the experiment.

3.1.2.3   The Contractor shall complete the development of any systems software necessary for performance of the experiment.

3.1.2.4   The Contractor shall perform application programming to complete the design, development, modification, installation, integration, testing, validation, and documentation necessary for the performance of the experiment. Required programming may include but is not limited to:

- Aircraft models and avionics systems
- Simulating ATC operations, aircraft target generation, and controller tools
- Out-the-window database development, moving model development
- Graphical displays for cockpits and controllers
- Modifications of aircraft models, avionics, ATC tools, and/or graphical displays to support new concepts and tools as required to meet the research objectives

3.1.2.5   The Contractor shall advise the researchers on the development of realistic flight scenarios, including possible events, malfunctions, etc. and airspace operations needed for the performance of the experiment. This may include training for researchers and/or participants and confederates on the use of simulators, modified or new instrumentation and automation, and ATC operations needed for the performance of the experiment.

3.1.2.6   The Contractor shall develop the data collection process to support the experiment, including, but not limited to, the definition of the parameters, data rate and volume, and data format.

3.1.2.7   For all experiments, the Contractor shall test individual simulation components, integrate the test the simulation, and obtain researcher concurrence that the simulation is ready to produce valid research data.

3.1.2.8   The Contractor shall do configuration control of facility software and hardware modifications required for an individual experiment.

3.1.3   Experiment Operations

The operations phase is the period from the start of the actual simulation experiment through its completion. During this period participants and researchers use the simulation.

Simulation experiment operations shall be implemented in accordance with the approved EIP. As part of the operations of a simulation experiment, the Contractor shall meet the following specific requirements:

3.1.3.1   The Contractor shall operate simulation experiments in accordance with written plans/procedures, and shall provide the flexibility to modify experiment parameters contingent upon interim experiment results.

3.1.3.2   The Contractor shall ensure integrity of the simulators prior to each day's experiment runs. The Contractor shall be responsible for documenting the setup, operation, and performance of each simulation in a consistent format.

3.1.3.3   The Contractor shall conduct safety briefings for participants, confederates, researchers, and visitors (if required).

3.1.3.4   The Contractor shall collect and verify data and perform daily and post-experiment data processing as required for each experiment. Data can include digital data files, video and audio recordings, participant surveys, and other data as specified by the researcher.

3.1.3.5   The Contractor shall record all system discrepancies that impact simulation experiments and ensure that they are resolved in compliance with NASA guidelines. The Contractor shall also log changes in systems status for each simulation conducted (e.g., electrical/electronic, mechanical, hardware/software, etc.)

3.1.4   Post-Experiment Operations

Subsequent to experiment completion, all documentation, post-experiment briefings, and other deliverables shall be completed and delivered to the appropriate NASA Lab Manager.

Simulation post-experiment operations shall be implemented in accordance with the approved EIP. As part of the post-experiment operations of a simulation experiment, the Contractor shall meet the following specific requirements.

3.1.4.1   The Contractor shall provide required outputs in accordance with simulation requirements, which may include but are not limited to:

- Data post-processed and distributed to the researcher per the EIP
- Project Management Notebook (PMN) including documentation of all modifications made to equipment to support the experiment.

3.1.4.2   The Contractor shall archive the PMN, simulation software, and lab configuration to ensure that the simulation can be repeated at a future time.

3.1.4.3   The Contractor shall record lessons learned in the PMN.

3.1.4.4   The Contractor shall support the NASA post-experiment briefing to review the operation and results of the experiment.

3.2   Discrete Projects

NASA will generate work assignments for discrete projects outside the bounds of simulation experiments, maintenance, and routine support functions. Discrete projects may also take the form of authorized Task Orders. Such projects may include proof of concept, research and development projects, demonstrations, facility refurbishment or upgrade, or other facility tasks. Discrete projects may support and advance NASA Programs and the Aviation Systems (AF) Division research goals as required.

As with the experiment activities of Section 3.1, Discrete Projects are expected to follow the standard process cycle including planning, preparation, implementation, and post-implementation activities, meeting the same requirements delineated in Section 3.1. The Contractor shall use the functional capabilities defined in Section 3.4, as necessary, to achieve the goals of each discrete projects or project.

Projects encompass analyses, design, acquisition, modification, or development, and integration, and verification of computers, system and applications software, graphics generators and displays, flight hardware systems, projectors and optical systems, structural modifications to

simulation systems and facilities, fabrication of mechanical structures, and development and fabrication of simulation mechanical systems.

The Contractor shall be responsible to NASA for analysis and recommendation of solutions in the above-mentioned areas, which may lead to acquisition of off-the-shelf solutions or in-house development and modifications. Follow-on activities shall include appropriate system level installation and checkout of these solutions

Customers may fund research projects not related to any facility.

3.3   Maintenance

The maintenance of SimLabs' facilities is significantly more complex than maintenance of standard training simulators. The unique nature of the equipment and the research and development environment requires different capabilities than needed to maintain a training facility. The Contractor shall be capable of troubleshooting, maintaining, and fixing complex simulation environments consisting of many integrated components including vender supplied software and hardware (some of which is vender proprietary), software and hardware modified or developed in-house, complex networks and servers, and distributed simulations within Ames and with other government and industry partners. The Contractor shall use the functional capabilities defined in Section 3.4 to accomplish the maintenance requirements.

3.3.1   Preventive Maintenance

3.3.1.1   The Contractor shall prepare and implement Preventive Maintenance Plans for the equipment listed in Attachment J.1(a) 4.

3.3.1.2   The Contractor shall provide all services necessary to maintain the simulation facilities and to maximize simulation systems uptime.

3.3.1.3   The Contractor shall recommend and procure spare parts sufficient to support routine maintenance/anticipated failures, and the tools required to maintain simulator equipment.

3.3.1.4   The Contractor shall implement and update a preventative maintenance schedule for SimLabs facilities and document the results and date of completion of each schedule PM item. The facilities are listed in Attachment J.1(a) 4.

3.3.1.5   The Contractor shall perform preventive maintenance of facility systems, including but not limited to:

- Provide mechanical maintenance in accordance with Simulation Facility Operations Manuals, NASA safety requirements, and manufacturer's service information and standard industry practices.
- Clean, lubricate, service, adjust, and tune the simulators, to support simulation schedules.
- Maintain digital computers and analog systems with associated peripherals, and interfaces.

- Maintain simulation lab hardware, such as simulation engineers control station/workstations, cameras, and audio/video equipment for data collection purposes.
- Maintain visual and graphics generation systems such as computer-generated out-the-window imagery systems, special symbology generators, and graphics workstations.
- Maintain visual and graphics presentation systems, such as high resolution display systems, projectors, head-up-displays (HUDs), optics in the cabs, displays, monitors, and video switching systems.
- Maintain control loaders and hydraulic power units.
- Maintain communications and audio systems such as aircraft sound systems, voice input/output systems, radio simulation equipment, and laboratory intercoms.
- Maintain cockpit instrumentation and displays.

3.3.1.6   The Contractor shall perform the following functions to ensure proper maintenance of software:

- Recommend when to upgrade OS and other vender software, integrate, install, and verify/validate vender software for each computer system.
- Purchase and renew software licenses and maintenance contracts as directed. Software licenses and contracts purchased under this contract shall be issued in the name of the Government.
- Maintain vender software documentation:
  - Archive vender software documentation and source code, license information
  - Maintain vender software configuration information for each computer
- Maintain in-house developed software documentation:
  - Produce and archive user and developer documentation for in-house developed software
  - Comment code for in-house developed software
- Support troubleshooting efforts when simulations are down, and incorporate and document solutions to reported problems.
- Perform system backups as necessary.
- Assist systems users and SimLabs customers where necessary.

3.3.2   Corrective Maintenance

Corrective maintenance will be performed as needed on all SimLabs equipment. Some in-house, some by third parties. Corrective maintenance is time critical.

Track corrective actions, review data periodically. Use results to recommend spare parts, and replacement of equipment that is becoming a downtime risk or is too expensive or nearly impossible to maintain.

The Contractor shall comply with NASA and SimLabs Configuration Control Board and IT security procedures and processes.

3.3.3   747-400 Flight Simulator Certification

The Contractor shall perform all testing and maintenance required to maintain FAA Level D equivalent certification on the 747-400 flight simulator. The Contractor shall follow FAA procedures and support the FAA on-site verification:

- Maintain all systems performance within FAA Level-D regulatory tolerances.
- Maintain all required certification documentation.
- Maintain test procedure manuals.
- Maintain test driver software.
- Acquire, set-up and operate certified test equipment.
- Conduct required periodic tests.

3.4   Functional Capabilities

The Contractor shall provide the following functional capabilities. The degree to which each of these capabilities will be called upon will be dependent upon the specific work assignments and/or authorized task orders generated.

3.4.1 Project Management

The Contractor shall provide project management support when more than one Contractor is assigned to a project. The Contractor will create a Work breakdown structure outlining all Contractor tasks, resources and schedule. The Contractor project manager will delegate tasks and manage the tasks which includes follow up and issue resolution. The contract project manager will raise any Contractor staff productivity or personnel issues to contract management for resolution. The Contractor project manager communicate status and results to the civil servant lead and any project team issues.

3.4.2   Systems Engineering

As necessary to complete work assignments and/or authorized task orders, the Contractor shall provide system engineering services to ensure the continuing operation and evolutionary improvement of the simulation facilities which may include, but is not limited to:

- Recommend, design, develop, integrate and verify facilities upgrades and new simulation capabilities, including the development of new simulators and/or simulation capabilities. This may include providing structural modifications to existing systems and facilities, performing systems analyses and designing simulator systems/subsystems, and providing the implementation planning, integration and testing for new simulation tools, software, operations interfaces, usability upgrades, and computational capabilities.

- Recommend, and integrate advanced technology into simulation systems. This may also include developing advanced engineering techniques to improve fidelity/validity of simulations.
- Recommend, design and integrate changes to networks; software and hardware infrastructure; software system architecture, and connectivity.
- Recommend upgrades to reduce the cost of simulation development, maintenance or operations.
- Ensure compliance with NASA and SimLabs IT Security and systems administration procedures and processes.

3.4.3   Software Development & Systems Administration

3.4.3.1   The Contractor shall provide the following software development capabilities. These requirements apply whether the software is system, applications, or infrastructure software and whether the software is associated with a SimLabs facility or not:

- Develop, integrate and verify specialized software such as real-time schedulers, debug packages, simulation development tools, input/ output routines, special device drivers, and connectivity, software between facilities.

- Develop software requirements from NASA, SimLabs user, or researcher requirements; and develop, integrate, and verify software that meets these requirements.

- Interface with NASA and SimLabs customers, and NASA projects to deliver status, schedules, plans, risks, and problems with a plan for remediation.

- Comply with SimLabs Software Development Procedures and applicable sections of NPR and APR 7150.

- Use a single software Configuration Management tool for all in-house developed software. Current, tested, versions of software, separate development versions, and previous versions of the software will be recognizable and accessible at all times.

- Document releases and train SimLabs staff on new software as necessary.

- Comply with NASA and SimLabs Configuration Control Board and IT security procedures and processes.

- Implement a system of programming standards, design, coding, and documentation methods.

- Provide data collection and reduction software.

- Perform system backups as necessary.

- Provide manuals and other documents, including those for training.

3.4.3.2   The Contractor shall provide system administration services for SimLabs simulation computers, servers, and networks in accordance with NASA and Ames directives, and the SimLabs infrastructure architecture to ensure the

integrity of real time operations, the security of proprietary and sensitive data, and compliance with IT security requirements.

3.4.4 Aerospace Engineering and Applications Programming

The Contractor shall perform aerospace engineering and applications programming to complete the design, development, modification, installation, checkout and documentation of all real-time models (e.g., models of advanced and existing aircraft for real-time computation) necessary to meet work assignments and/or authorized task orders, which may include, but is not limited to:

- Integration of auto-coded MatLab math models into the simulation real-time infrastructure
- Ground reactions and ground handling models
- Primary and secondary flight control systems
- Auto flight systems
- Avionics systems
- Propulsion systems
- Fuel system
- Hydraulic systems
- On-board auxiliary systems
- Air conditioning/pressurization systems
- Navigation systems programs
- Detection/communication systems
- Maintenance or creation of new navigational data bases (terrain profiles, radio facilities, etc.)
- Development and modification of advanced aircraft models and air traffic control management for real-time computation
- Determination of methods to provide effective visual/motion cues to simulator pilots
- Scenario development

3.4.5 Graphics Programming

As necessary to meet the requirements of an experiment or individual work assignments or authorized task orders, the Contractor shall complete or modify the design, development, installation, checkout and documentation of all graphics, text and display software, which may include, but is not limited to:

- Development, integration and verification of real-time graphics software including out-the-window 3-D database development, moving models, video streaming software, and aircraft or ATM automation and displays. Databases and moving models are either vender supplied, in-house modified, or in-house developed.

- Development, integration and verification of text and graphic displays for aircraft heads-down and heads-up displays, and simulation control displays.

3.4.6 Hardware and Mechanical Systems Engineering

Hardware and mechanical systems can be separate systems or several sub-systems interconnected as a larger system. The Contractor shall:

- Design, fabricate, modify, assemble, and integrate hardware and equipment for simulation research operations and discrete projects. Tasks may include fabrication of original equipment from design drawings or sketches and/or modification or changes to existing hardware and systems including but not limited to cab instrument panels and consoles, floor panels, seats, visual display support structures, sheet metal assemblies, pilot control devices such as sticks, grips, surface controls, and power management mechanisms.
- Design, develop, maintain, operate, and modify simulation mechanical, hydraulic, electrical/electronic, and servo systems.
- Provide structural modifications to systems and facilities.
- Design, fabricate or modify electronic chassis, assemblies and subassemblies, and cables using wire wrap, termi-point, soldering, and potting techniques.
- Support hardware-in-the-loop simulation by integrating customer provided hardware into the simulation system.
- Develop/maintain equipment operations and maintenance logs for usage/configuration and availability, including discrepancy reports.
- Understand/manage diverse hardware/software environment.
- Provide integration of new hardware systems.

3.4.7 Aviation System Operations

As necessary to meet the requirements of individual work assignments and/or authorized task orders, the Contractor shall operate and evaluate the performance of the facility, including providing subject matter expertise to help develop and test experiment scenarios, conduct flight system operations training, provide specialized experiment support and experimental test subjects.

3.5 Core Functions

The successful long-term performance of the simulation facilities is dependent on efficient and effective on-going additional functions. These additional functions, further defined below, provide the logistics and infrastructure necessary to keep the facilities operating.

3.5.1 Management/Administration

The Contractor shall provide an overall management and administrative function to ensure that the proper resources are available and allocated, that adequate reports and documentation are prepared, and that the overall environment supports the experiment requirements. The Contractor shall provide for overall management and administrative functions to meet the requirements.

3.5.1.1   The Contractor shall manage the contract in a fiscally responsible manner. The Contractor shall seek, and recommend to NASA, opportunities to operate more efficiently or at lower cost while meeting all other requirements.

3.5.1.2   The Contractor shall provide a well-defined, stable organizational structure with clear lines of authority and clearly identified Government interfaces.

3.5.1.3   The Contractor shall ensure the facilities are available for scheduled simulation experiments. All work areas will work shifts depending upon facility, simulation, maintenance, and development schedules and/or availability of laboratory and facility equipment.

3.5.1.4   The Contractor shall manage the contract resources allocated by NASA for specific projects in a manner to ensure experiments are performed in accordance with published schedules.

3.5.1.5   The Contractor shall identify and advise NASA on critical skills needed to maintain existing capabilities and enhance future capabilities

3.5.1.6   The Contractor shall provide supplies and services acquisition in accordance with NASA's and its own purchasing procedures as approved by the Government.

3.5.1.7   The Contractor shall prepare and implement a discrepancy reporting and tracking system.

3.5.1.8   The Contractor shall provide a monthly report of the state of the facilities, identifying risks and critical issues.

3.5.1.9   The Contractor shall maintain and update current plans and procedures to ensure the facilities consistently meet requirements. Plans and procedures that currently exist will be made available to the Contractor and may be used to assist in the fulfillment of this requirement.

3.5.1.10   The Contractor shall document and obtain approval from the Contracting Officer and the NASA Contracting Officer's Representative (COR) for all deviations, waivers, and non-compliance to the requirements of individual work assignments and/or authorized task orders.

3.5.1.11   The Contractor shall have the ability to quickly obtain necessary resources to perform specialized, short duration, discrete work to be conducted for SimLabs as needed.

3.5.1.12   The Contractor shall ensure compliance with NASA and SimLabs processes and procedures for simulation development and execution, software and hardware development, IT Security, and configuration management, procedures

3.5.1.13   The Contractor shall provide and maintain a workforce with appropriate technical and customer interface skills. In furtherance of this goal the Contractor shall provide mentoring and training, and show skill in hiring and during layoffs.

3.5.2   Outreach

SimLabs primarily exists to support NASA programs. SimLabs' mission is to research, advance, and transfer scientific simulation knowledge and understanding. In addition, as NASA programmatic commitments will allow, facility time and functional capabilities can be made available for other Government agencies, Academia and Private Industry to perform projects that will enhance facility operations and/or exploit the unique capabilities of the SimLabs' facilities and functional capabilities. The Contractor shall support the Government's efforts to maximize facility and functional capability utilization.

3.5.2.1   The Contractor shall support the Government's analysis of program requirements and shall support the outreach efforts of the Government to provide information regarding SimLabs' mission to potential users. This support shall include the maintenance of a contact database of current and potential SimLabs customers, support in developing Government proposals to potential users, tours of the SimLabs facilities, development of communication materials (including posters and brochures), maintenance of the SimLabs website, support of educational outreach and support in sharing SimLabs facility capabilities at professional conferences.

3.5.2.2   The Contractor shall develop an outreach plan targeting other NASA programs, other NASA Centers, the Federal Aviation Administration, industry and universities. This outreach plan will identify potential new customers, communication efforts, and demonstrations of SimLabs' capabilities.

3.5.2.3   The Contractor shall develop brochures and newsletters highlighting new simulation capabilities and facility upgrades. The Contractor shall communicate those highlights to current and potential customers.

3.5.3   Procurement

The Contractor shall provide procurement services for materials, equipment and services required for the ongoing SimLabs operations. In addition to purchasing materials and equipment for day-to-day operations, the Contractor shall also purchase materials and equipment for discrete projects, quick turnaround maintenance purchases and expertise when necessary to ensure success of a project or enhance facility performance. All procurement activity shall be in accordance with all Federal Acquisition Regulations (FAR) and NASA regulations.

3.5.4   Property Management

The Contractor shall work with NASA Property Management to tag new equipment and enter it into the NEMS system where required, track tagged and untagged SimLabs equipment, assist in the Ames property inventories, and excess equipment no longer needed.

3.5.5   Safety and Mission Assurance (SMA)

The Contractor shall develop, maintain, and implement a comprehensive Risk Management Plan addressing at least Technical, Cost, Schedule, Safety, and Security risks.

To ensure the facilities are operated in a safe and reliable manner, with adequate quality controls, the Contractor shall meet the SMA requirements listed below, as well as relevant NASA SMA Policies, procedures and guidelines.

3.5.5.1 Environmental Compliance

The Contractor shall identify and maintain records for all hazardous materials and obtain permits through the Ames Environmental Office   in accordance with the Ames Environmental Handbook Procedural Requirements (APR 8800.3) and in coordination with the COTR.   The Contractor shall comply with the applicable regulations included   in Chapter 1 of the APR and the other applicable procedures and guidelines specified in the APR.

3.5.5.2 System Safety

The Contractor shall provide copies of valid certifications from vendors providing DOD or FAA parts or services.

The Contractor shall perform all tasks so as to provide for the Protection of Human Research Subjects (NPR 7100.1).

The Contractor shall meet Human Research Planning and Approval Guidelines in accordance with APR 7170.1. The Contractor shall be an active participant in the Government Industry Data Exchange Program (GIDEP). As necessary, projects including significant design, fabrication or modification to motion simulators and/or their equipment shall require review and approval through the Human Occupancy Review Board.

The Contractor shall carry out safety testing and maintenance in accordance with safety requirements as approved by Code Q.

3.5.5.3 Occupational Safety

The Contractor shall be an active participant of Voluntary Protection Program (VPP) and comply with safety standards consistent with Management of Basic and Applied Research APR 1700.1 for all tasks under this contract.

The Contractor shall determine the appropriate safety equipment (safety glasses, shoes, ear protection, etc.) and ensure that it is available to protect personnel.

3.5.5.4 Reliability

The Contractor shall preserve and ensure facility (VMSC, FFC, CVSRF, DSRL, and 210 ATC Lab) integrity in terms of availability, reliability and maintainability such that facilities, including all development systems and support equipment, are operational and perform to requirements during

scheduled operations. The Contractor shall keep statistics of downtime, and use these to make recommendations to reduce downtime.

3.5.5.5 Quality Assurance

The Aerospace Systems Division (Code AF) is required to maintain current up-to-date operational, safety, maintenance, quality etc. policies and procedures in accordance with the Ames Management System. The Contractor shall be responsible for complying with and supporting all Ames Management policies and procedures, including AF Division policies and procedures, and to provide for the integration of all policies and procedures into the Ames Management System. The Contractor software development processes for Class C and Class D software shall comply with NASA requirements such as NASA Software Engineering Requirements NPR 7150.2.

3.5.6 Configuration Management

To ensure the facilities are operated in a regular, consistent and known manner, that their performance levels are measured and recorded, that a historical record of activities are maintained, the Contractor shall meet the requirements listed below:

3.5.6.1 The Contractor shall establish, maintain and implement a software and hardware configuration management plan in accordance with the Ames Management System, IT security requirements, NASA Software Engineering Requirements, AF Division policies, and NASA project requirements.

3.5.6.2 The Contractor shall maintain the facilities' documentation libraries and ensure that they are current, accurate and complete, including but not limited to:

- All operating procedures and reference manuals.
- Records of measured simulator performance parameters.
- Documentation recording the performance of experiments including project notebooks/work files, significant repairs/ upgrades and preventative maintenance records.
- Manufacturer's manuals, bulletins, parts lists, and vendor source lists.
- Facility software and hardware configurations.

3.5.7 Phase-In / Phase-Out

3.5.7.1 Phase-In: The phase-in process shall be accomplished as expeditiously as possible, with a maximum phase-in period of 30 days. The phase-in process shall not adversely impact the work being done by the outgoing Contractor. It shall be conducted in a manner consistent with safe operation requirements. The incoming Contractor is responsible for providing a qualified Contractor staff by the end of the phase-in period.

3.5.7.2 Phase-Out: Upon completion of this contract, the outgoing Contractor is responsible for the orderly transfer of duties and records to the incoming

Contractor. This should be accomplished in an expeditious manner, consistent with any contract phase-in schedule, while minimally impacting ongoing task orders. The Contractor shall submit a phase-out plan no later than 60 days before the end of the contract for Government review and approval.

4.0 Abbreviations and Acronyms

ACFS	Advanced Concepts Flight Simulator
AF	Aviation Systems Division
AHB	Ames Handbook
APD	Ames Policy Directive
APR	Ames Procedural Requirements
ARC	Ames Research Center
ATC	Air Traffic Control
COTR	Contracting Officer's Technical Representative
CVSRF	Crew-Vehicle Systems Research Facility
DOD	Department of Defense
DSRL	Distributed Simulation and Research Laboratory
EIP	Experiment Implementation Plan
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulations
FFC	FutureFlight Central
HUD	heads-up-display
ICAB	Interchangeable Cab Simulator (Fixed Base Area)
IPP	Installation-Provided Property
NASA	National Aeronautics and Space Administration
NMI	NASA Management Instruction
NPR	NASA Procedural Requirements
QA	Quality Assurance
SOW	Statement of Work
SMA	Safety and Mission Assurance
V/STOL	Vertical/Short Takeoff and Landing
VMS	Vertical Motion Simulator
VMSC	Vertical Motion Simulator Complex

5.0 Proprietary Software

The Contractor will be required to utilize and support all software included in Attachment J.1(a) 5.